{{<P=41><C=06><S=extension><T=SQ><M=5><L=1><X=F><id=001>}}

4162001

F E The r.m.s. value of the mains supply in Taiwan is 110 V.

(a) Calculate the peak voltage of the mains. (2 marks)

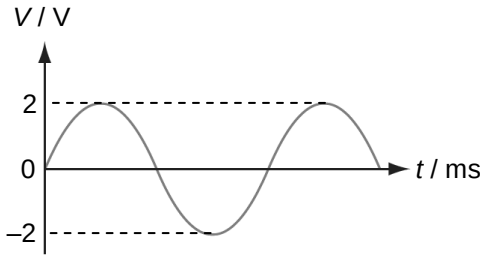
(b) A resistor of 100 Ω is connected to the mains supply.

(i) Find the average power developed in the resistor. (2 marks)

(ii) A steady voltage V_{dc} is now applied to the resistor. What should be the value of V_{dc} to maintain the same average power as in (i)? (1 mark)

4162002

F E A student connects an a.c. source to a 10-Ω resistor and a CRO. The figure below shows the trace on the CRO.



(a) What is the peak-to-peak value of the voltage? (1 mark)

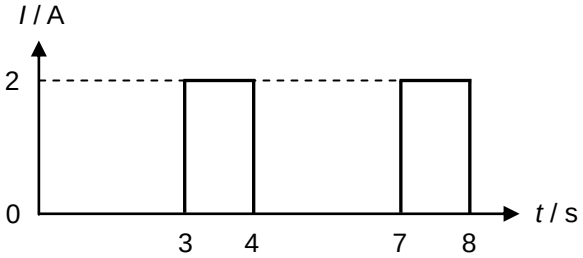
(b) Find the maximum power of the resistor. (2 marks)

(c) Find the r.m.s. value of voltage. (2 marks)

(d) Hence, find the average power of the resistor. (2 marks)

4162003

F E The figure below shows the variation of a current I with time t.



(a) Is the current shown above an a.c. or a d.c.? (1 mark)

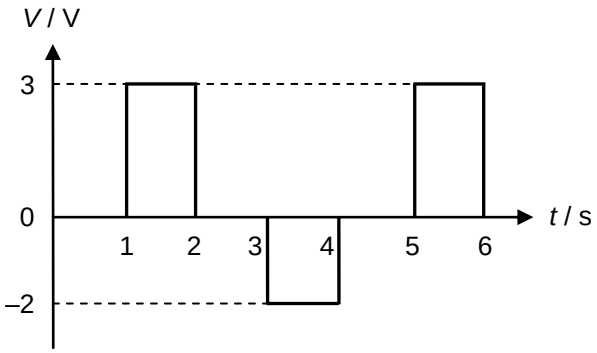
(b) Find the mean value of the current. (2 marks)

(c) Find the root-mean-square value of the current. (2 marks)

(d) The current above is then allowed to pass through a resistor. If another steady current I_1 gives the same heating effect in the same resistor in the same time as this current does, what is I_1? (1 mark)

4162004

F E The voltage V of an a.c. source varies with time t as shown.



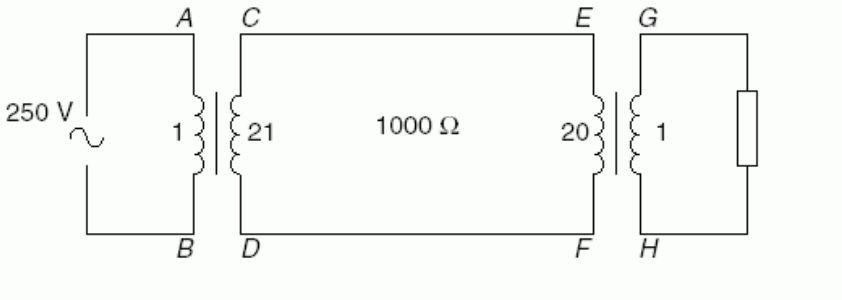
(a) Find the mean value of the voltage. (2 marks)

(b) Find the root-mean-square value of the voltage. (2 marks)

(c) If the voltage is applied to a 15-Ω resistor, what is the average power dissipated by the resistor? (2 marks)

4162005

E The following figure shows a power line for transmitting electrical power from a power station to a factory. The station generates electricity at 250 V a.c. A step-up transformer of turns ratio 1 : 21 is used at the power station side of the power line and a step-down transformer of turns ratio 20 : 1 is used at the factory side.



(a) Calculate the voltage across *CD*. (2 marks)

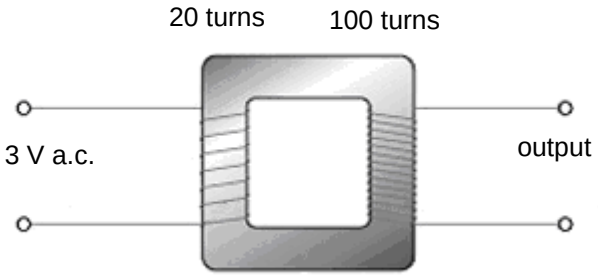
(b) The power line has a resistance of 1000 Ω and the current through the line is 0.25 A.

(i) Calculate the voltage drop along the power line. (2 marks)

(ii) What is the voltage across *GH*? (2 marks)

4162006

E The following transformer is connected to a 3-V a.c. supply.



(a) If the current in the secondary coil is 0.1 A and the power loss in the transformer is 0.3 W, what is the primary current? (4 marks)

(b) Suggest two methods to increase the efficiency of the transformer. (2 marks)

4162007

★

E The input voltage and current of a transformer for a computer hub are 240 V and 120 mA respectively.

(a) Find the input power of the transformer. (2 marks)

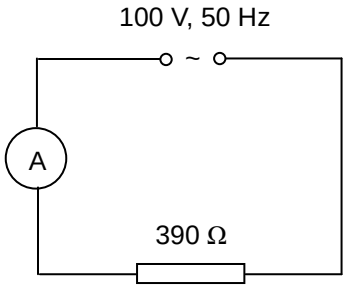
(b) If the efficiency of the transformer is 87%, find the power loss in the transformer. (2 marks)

(c) Suggest a main reason for the power loss. In what form of energy is lost in the transformer? (2 marks)

4162008

★

F E In the figure below, an ammeter of internal resistance 10 Ω and a 390-Ω resistor are connected to an a.c. power supply. The root-mean-square value of the voltage and the frequency of the power supply are 100 V and 50 Hz respectively.



(a) What is the r.m.s. value of the current in this circuit? (3 marks)

(b) What is the r.m.s. value of the voltage across the 390-Ω resistor? (2 marks)

(c) What is the peak value of the current in the circuit? (2 marks)

(d) What is the maximum power dissipated by the 390-Ω resistor? (2 marks)

4162009

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F E (a) What is meant by 'the effective value of an a.c.'? (2 marks)

(b) What is the relationship between the effective value I_e and the r.m.s. value I_{rms} of an a.c.? (1 mark)

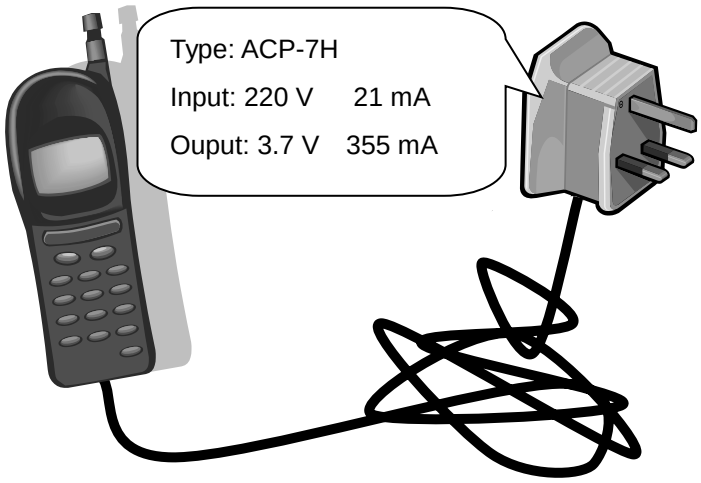
(c) What is the relationship between the peak value I_0 and the r.m.s. value I_{rms} of a sinusoidal alternating current? (1 mark)

(d) If the value of a steady direct current and the peak value of a sinusoidal alternating current are equal, calculate the ratio of the average power dissipated by a resistor of resistance R by the direct current to that by the alternating current. (2 marks)

4162010

★

E The label on a mobile phone charger is shown below.



There is a transformer in the charger.

(a) Is it a step-up transformer or a step-down transformer? (1 mark)

(b) Find the turns ratio of the transformer. (2 marks)

(c) Calculate the efficiency of the transformer. (3 marks)

4162011

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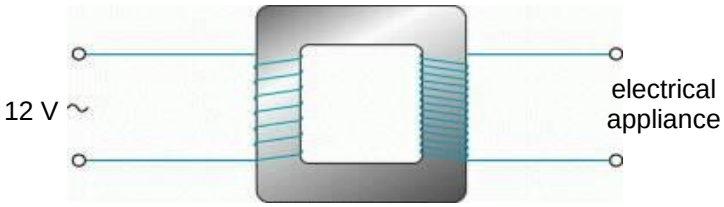
E The following figure shows a transformer with turns ratio 1 : 20. The primary coil is connected to a 12 V a.c. power supply to operate an electrical appliance connected to the secondary coil.



(a) What is the type of the transformer, step-up or step-down? Explain your answer briefly. (2 marks)

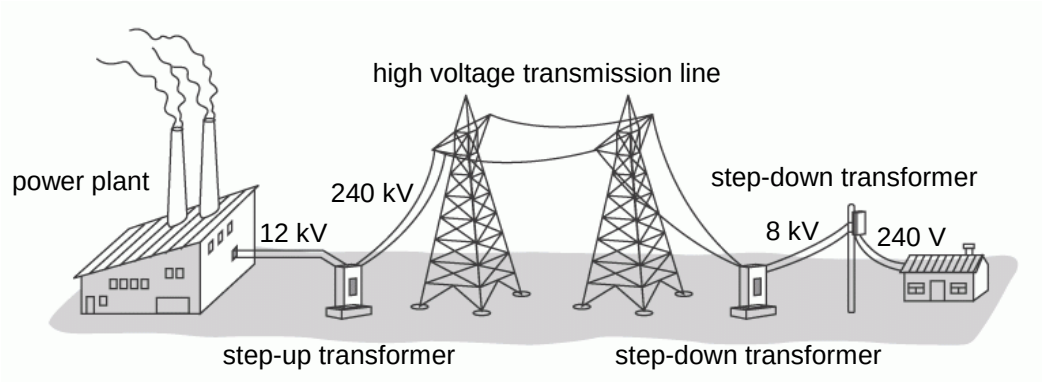
(b) Suppose that the primary current of the transformer is 125 A and the current through the electrical appliance is 5 A. Find the efficiency of the transformer. (4 marks)

(c) State two methods to increase the efficiency of a transformer. (2 marks)

4162012

★

E The following figure shows how electricity is transmitted from a power plant to households.



(a) (i) The step-up transformer changes the voltage from 12 000 V to a higher value of 240 000 V. What is the turns ratio of the transformer? (2 marks)

(ii) Does the step-up transformer also change the transferred energy to a higher value? (1 mark)

(b) The power output of the power plant is 36 MW. The total resistance of the transmission line is known to be 150 Ω.

(i) Find the current through the transmission line by assuming the step-up transformer is ideal. (3 marks)

(ii) Hence, find the percentage loss of power in the transmission line. (3 marks)

4162013

★★

F E (a) What is meant by the 'peak value' and the 'effective value' of an alternating current? (3 marks)

(b) A sinusoidal alternating current can be expressed as $I = 24 \sin 100\pi t$. Find

(i) the frequency

(ii) the peak value

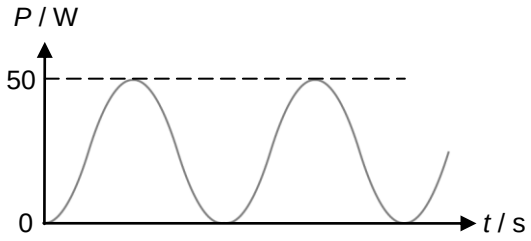
(iii) the effective value

of this alternating current. (4 marks)

4162014

★★

F E The graph below shows how the input power of a transformer varies with time.



The turns ratio of the transformer is 1 : 150 and the r.m.s. value of the primary voltage is 6 V. Assuming that the transformer is ideal, calculate

(a) the r.m.s. value of the secondary voltage, (2 marks)

(b) the average input power, (2 marks)

(c) the r.m.s. value of the primary current, and (2 marks)

(d) the r.m.s. value of the secondary current. (2 marks)